Flood Management Enhancement Using Remotely Sensed Data

Fourth Milestone Period Report

Prepared by
Gregory J. Romanowski

SENTAR, Inc.
4910 Corporate Drive, Suite C
Huntsville, AL 35805
(205) 430-0860

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Goddard Space Flight Center, Code 912
Greenbelt Road
Greenbelt, MD 20771

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INTRODUCTION

Background. SENTAR, Inc., entered into a cooperative agreement with NASA Goddard Space Flight Center (GSFC) in December 1994. The intent of the NASA Cooperative Agreement is to stimulate broad public use, via the Internet, of the very large remote sensing databases maintained by NASA and other agencies, thus stimulating U.S. economic growth, improving the quality of life, and contributing to the implementation of a National Information Infrastructure. SENTAR heads a team of collaborating organizations in meeting the goals of this project. SENTAR's teammates are the NASA Marshall Space Flight Center (MSFC) Global Hydrology and Climate Center (GHCC), the U.S. Army Space and Strategic Defense Command, and the Alabama Emergency Management Agency (AEMA).

For this cooperative agreement, SENTAR and its teammates are accessing remotely sensed data in the Distributed Active Archive Centers, and other available sources, for use in enhancing the present capabilities for flood disaster management by the AEMA. The project is developing a software system that addresses prediction, warning, and damage assessment for floods. The objectives of the prototype system are to demonstrate the added value of remote sensing data for emergency management operations during floods and the ability of the Internet to provide the primary communications medium for the system. The key to achieving these objectives will be the development of the Emergency Management Tool that will provide an integrated interface for the emergency operations staff to acquire and manipulate source data and data products to generate and distribute new data products to support their mission. The prototype system will also establish a systems infrastructure that is easily expandable to include additional flood-related data and models or to other disasters with their associated remote sensing data requirements and distributed data sources.

Scope. This report covers the work performed during the fourth milestone period of the project, which began on 2 October 1996 and ended on 16 February 1996.

Purpose. The purpose of this report is to: 1) document the successful completion of all the fourth period milestones and 2) to provide a status of the significant accomplishments, problems encountered, and requests for assistance from NASA during the fourth milestone period and plans for the fifth milestone period. This information is intended to provide project insight to the NASA Technical Officer to assure that all necessary steps are being taken to maximize the probability of success.

SUMMARY OF ACTIVITIES

Significant Accomplishments. SENTAR had three products for the fourth milestone period. These were:

1. An end of milestone period status report
2. The completed design concept for the prototype system
3. A software applications list for the prototype system.

These three products have been successfully completed. This report constitutes the completion of the first product. The other two products are included with this report as separate documents. The following paragraphs document the completion of these two products, along with a summary of the other project accomplishments and activities achieved during this milestone period.

Design Concept Document. The prototype system design concept that was started in the third milestone period was completed during the fourth milestone period. The major system components of the prototype system design concept are a Data Processing Center (in Huntsville, AL), the AEMA Emergency Operations Center (EOC) (in Clanton, AL), external data sources, and remote or county-level users. The Data Processing Center accesses spatial feature data and remote sensing data from various sources and processes the data for storage and use at the AEMA EOC. At the EOC, the processed data will be stored for use by emergency operations staff. In addition, other remote sensing and emergency management data/information will be accessed and stored at the EOC directly from external sources. These data will then be used by the emergency operations staff through an Emergency Management Tool to produce graphical products for use by the center and by field county EMA users. The Emergency Management Tool is the software program that creates a common user interface for accessing the suite of software applications for utilizing the data. The principal software will be a GIS viewer for displaying, combining, and analyzing the data stored in georeferenced data coverages (or data layers) and a World Wide Web (WWW) browser for viewing GIF and JPEG imagery. It is within the GIS viewer that different data sets will be combined to produce the data products to support emergency operations both internal to the EOC and for external users, primarily field and county EMA users. Some of these data products will also be incorporated into a WWW home page, which will provide for public access to selected emergency planning, disaster assessment, and recovery information via the Internet. The design concept is described in detail under a separate report entitled, "Flood Management Prototype System Design Concept."

Software Applications List. The system design concept makes extensive reuse of existing software products to provide system components wherever possible. The system design will use the existing software at AEMA or those software packages already planned to be acquired to support the required functionality of this system, where possible. Where these software packages will not meet the functional needs of the prototype system, software will be developed by SENTAR. The specific existing software to be used and the software programs, components, and utilities to be developed are listed in a separate document entitled, "Prototype System Software Applications."

<u>Miscellaneous Activities</u>

1. SENTAR's principal investigator, Greg Romanowski, attended the second NASA CAN PI meetings at RSPAC in West Virginia, and presented a poster session of the developing design concept. An initial demonstration was also set up at the PI meeting.

2. SENTAR's principal investigator, Greg Romanowski, and Dr. Doug Rickman of the MSFC GHCC presented a briefing on this project at the 1995 Fall Meeting of the American Geophysical Union held in December. The briefing at the special session on Monitoring of Floods and Droughts with Remote Sensing focused on the specific remote sensing data that are planned to be used and the rationale for the selection in terms of the planned system, the range of issues that were considered in the selection process, and the planned application of the selected remote sensing data within the phases of emergency management operations (i.e., planning, response, recovery). This conference provided us with contacts within the National Weather Service who are developing a long-range flood forecasting model and a company developing a model for more precise area definition for near-term flooding. These contacts are being pursued and may have application for incorporation into our design.

3. SENTAR initiated the rebuilding of the project home page. It was restructured to accommodate the presentation of the complete design concept and a demonstration of the prototype system as it develops. During the fifth milestone period these two areas will be populated.

Problems Encountered

<u>Internet Connectivity</u>. AEMA is still in the process of establishing Internet access through the Alabama Supercomputer Network operated by the Alabama Supercomputer Authority. Until this access is implemented, Internet access will be provided through the MSFC GHCC using their 800 dial-up service. The accounts have been set up and some of the AEMA users are on-line, however some users are still encountering problems using this account.

<u>Budget Uncertainty</u>. The federal budget impasse between Congress and the President had slowed progress significantly for the first part of FY96. Starting in January, the work level was raised to the original rates to insure that the prototype system could be developed this year, despite the continuing uncertainty about the budget.

<u>Data Acquisition</u>. The planned purchase of additional satellite data was delayed from the fourth milestone period to the fifth due to the budget uncertainties.

Requests for Assistance from NASA

The technical assistance requested from NASA GSFC during this milestone period consisted of guidance as to how and at what level to proceed with the effort, considering the budget uncertainties. SENTAR was told to proceed at a reduced level of effort.

Support for the technical assistance requests was provided by RSPAC. They provided telephone consultation on questions related to HTML and home page development, recommendations for

software utilities and places to get shareware or freeware versions, and additional advise on the logging home page accesses. RSPAC was timely and helpful in their responses to our queries.

PLANNED ACTIVITIES

The planned work activities for the next milestone period are:

1. Complete the Prototype System Software Design. Initial work on the software design was started near the end of the fourth milestone period as the Design Concept was being documented and after the list of software to be developed was produced. During the first half of the fifth milestone period this software design will be completed and documented.

2. Develop Prototype System Software. As the software design for elements of the system are completed, the software development phase will be initiated. By the end of the fifth milestone period, 50% of the software to be developed will be written and integrated with the existing software components.

3. Continue RSD Data Review. SENTAR will complete on-going discussions with the EROS Data Center on defining all applicable Landsat data available for Alabama and will begin acquiring and processing additional Landsat data. Similarly, we will restart the effort to acquire SPOTView data. SENTAR will also contact the synthetic-aperture radar satellite data providers to identify the available data, the cost of the data, and the timelines for acquiring data. This information will be used to determine the possible acquisition of these data, either on this effort or for future operations. This activity was initiated, but not completed during the fourth milestone period.

4. Airborne Photography. SENTAR's previous review of the available satellite RSD has identified limitations in using these data due to issues of infrequent satellite availability over disaster areas, long processing time to acquire processed data from providers, cloud cover, and data cost. The use of airborne photography can eliminate many of these issues, but causes other issues in terms of the small area of coverage and distortion due to greater incidence angles of the camera to the ground. SENTAR will acquire airborne photographs of the Northern Alabama region to determine the utility of these images and to develop the specific procedures to process the images into georeferenced raster files for use in the GIS.

5. Collect Available Source Data for GIS Data Layers. Based on the planned data layers, SENTAR and AEMA have identified sources for the data to populate the planned data layers. AEMA has provided contacts for the state GIS source data and initial contact has been made to determine who to work with the format and media of the available data and the level of coverage for the state of Alabama. During the fifth milestone period the actions necessary to have the data released to AEMA will be identified and addressed.

6. Prepare Demonstration Plans. SENTAR working with AEMA will develop two demonstrations to exercise the prototype system once developed. These plans will be designed to exercise all major functionality of the system, and will be tailored to the operational environment of the AEMA EOC.

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7. <u>Integrate RSD Image Data into GIS Data Layers</u>. As SENTAR acquires the specific RSD images to be included in the prototype system, the images will be reformatted for importing into ARC/INFO, where necessary, and will be integrated with the existing GIS data layers. The initial images will undergo a close quality inspection to resolve any issues with correct georeferencing between the RSD images and the GIS data. This activity was deferred from the fourth milestone period.

8. <u>Continue to Upgrade Home Page</u>. The project home page structure was revamped during the last milestone period to accommodate the design concept and a demonstration of the prototype system. During the fifth milestone period the design concept document will be integrated into the home page as will be the evolving prototype system.